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Proceedings of the regional science advisory process for the assessment of and recommended sustainable harvest level for Dolly Varden from the Big Fish River, Northwest Territories

Compte rendu du processus d'avis scientifique régional concernant l'évaluation et la recommandation de niveaux de prises durables pour le Dolly Varden dans la rivière Big Fish, aux Territoires du Nord-Ouest

February 29, 2012
Winnipeg, Manitoba

Le 29 février 2012
Winnipeg, Manitoba

Margaret Treble
Meeting Chairperson

Margaret Treble
Présidente de réunion

Kristen Adair
Editor

Kristen Adair
Éditrice

Fisheries and Oceans Canada / Pêches et Océans Canada
Freshwater Institute / Institut des eaux douces
501 University Crescent / 501, University Crescent
Winnipeg MB R3T 2N6
Canada

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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. Le compte rendu peut aussi faire l'état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenues dans le présent rapport puissent être inexactes ou propres à induire en erreur, elles sont quand même reproduites aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considérée en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

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200, rue Kent Street
Ottawa, Ontario
K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/

CSAS-SCCS@DFO-MPO.GC.CA

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SUMMARY

A Regional Advisory Process was held at the Freshwater Institute in Winnipeg to assess Dolly Varden (*Salvelinus malma*) from the Big Fish River, Northwest Territories. The meeting was held on February 29, 2012 and included participants from Fisheries and Oceans Canada, Fisheries Joint Management Committee, the West Side Working Group, Gwich'in Renewable Resources Board, University of Manitoba, University of Alberta, and an independent expert. During the meeting, presentations were made on the following items: data collected between 2009 and 2011 used to estimate abundance based on mark-recapture studies; estimates of the number of migrating Dolly Varden enumerated using a DIDSON camera, determination of the effective population size and an estimate of population abundance based on these results; description of the current biological characteristics of the population; determination of the contribution of the Big Fish River stock to the coastal mixed-stock fishery; and estimation of the current harvest level for the stock. Discussion during the meeting included the applicability of using the DIDSON results to determine population abundance estimates, relevance of relying on one year of sampling to characterise the coastal mixed-stock fishery, and information to consider when making decisions about a possible fishery at the mouth of the Big Fish River. This Proceedings report summarizes the relevant discussions.

SOMMAIRE

Un processus de consultation régional s'est déroulé à l'Institut des eaux douces, à Winnipeg, afin d'évaluer le Dolly Varden (*Salvelinus malma*) de la rivière Big Fish, dans les Territoires du Nord-Ouest. La rencontre, qui s'est tenue le 29 février 2012, a rassemblé des participants provenant de Pêches et Océans Canada, du Comité mixte de gestion de la pêche, du groupe de travail du côté ouest, de l'Office des ressources renouvelables des Gwich'in, de l'Université du Manitoba et de l'Université de l'Alberta ainsi qu'un expert indépendant. Pendant la rencontre, des exposés ont été présentés sur les sujets suivants : les données recueillies au moyen d'études de recapture de poissons marqués entre 2009 et 2011, utilisées pour estimer l'abondance; le nombre de Dolly Varden en migration, estimé grâce à une caméra DIDSON, la détermination de la taille effective de la population et une estimation de l'abondance de la population selon ces résultats; la description des caractéristiques biologiques actuelles de la population; la détermination de la contribution du stock de la rivière Big Fish à la pêche du stock côtier mélangé; et l'estimation des niveaux de prises actuels du stock. Les discussions ont notamment abordé la faisabilité de l'utilisation des résultats de la caméra DIDSON pour estimer correctement l'abondance de la population, la pertinence de se fier à des échantillons recueillis sur un an pour caractériser la pêche du stock côtier mélangé, et les renseignements à prendre en compte au moment de décider de l'éventualité d'une pêche à l'embouchure de la rivière Big Fish. Le présent compte rendu résume les discussions pertinentes qui ont eu lieu.

INTRODUCTION

The meeting began with a review of the meeting terms of reference (Appendix 1), introductions of participants (Appendix 2) and review of the agenda (Appendix 3). The meeting Chair indicated that on February 28, 2012 the Fisheries and Oceans Canada (DFO) acting Director for the Western Arctic Area had requested that the sixth objective in the Terms of Reference (ToR) (Evaluation of the sustainable harvest level and the associated risks for the stock) not be addressed at the meeting. He felt that this was the role of the Dolly Varden Integrated Fisheries Management Plan (IFMP) steering committee and not DFO Science. The Chair proposed to not address item number six in the ToR. There were no objections from participants and the item was removed from the agenda.

A request was made by a participant to clarify the 'Context' section in the ToR in order to better reflect the current management of Dolly Varden in the Inuvialuit Settlement Region (ISR). It should have been made clear that the stock is covered under an IFMP and that there is an advisory group responsible for its implementation. The meeting Chair acknowledged that this information will be clarified in the other publications from this regional advisory process

A point was made by a participant that the management of the stocks in the ISR is done in partnership between DFO and the Inuvialuit.

Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

PRESENTATION: POPULATION ABUNDANCE ESTIMATES

Presenter: Colin Gallagher

Mark-recapture data collected between 2009 and 2011 used to generate abundance estimates of Dolly Varden from the Big Fish River in 2009 and 2010 were presented. The assumptions of mark-recapture were reviewed and background information provided on how adjustments were made to the data when some of the assumptions were violated. Two ninety-five percent confidence intervals were shown for each population estimate; one assuming the probability of recapture events followed a normal distribution and a second assuming a Poisson distribution. Data from a Dual Frequency Identification Sonar (DIDSON) deployed in the Big Fish River in 2010 in an attempt to enumerate the migratory component of Dolly Varden from the Big Fish River were also presented. Data from the DIDSON were tabulated in multiple ways to represent counts of fish at different lengths intervals and incorporating a correction factor for those <400 mm in length to account for the presence of species other than Dolly Varden. The results from the mark-recapture were compared to the DIDSON to examine if the values were similar, although it was recognized that the DIDSON did not enumerate the entire migratory component of the population. The abundance estimates from the mark-recapture were compared with past mark-recapture abundance estimates obtained periodically between 1972 and 1998 to determine if there had been any significant changes.

DISCUSSION

A concern was raised in regards to the figure of the daily DIDSON counts plotted against stream width and the interpretation that high water was negatively correlated with fish movements. It was suggested to use more cautious language with the interpretation.

One participant cautioned using the DIDSON data in the same sense as a population estimate. A statement was made that the DIDSON results are not a population estimate and are only a snapshot count at a given location without confidence limits. A concern was also raised that continuing to use the DIDSON number in the context of a 'population estimate' will eventually appear in the literature and people will believe that it actually is an estimate. The participant elaborated further by saying that mark-recapture is an actual estimate generated using calculations with testing of assumptions. Participants agreed to express the mark-recapture as a population estimate and the DIDSON data as counts.

Another participant asked why the DIDSON was used in a system with a time series of mark-recapture estimates. The reply was that the DIDSON was used to examine an alternative to tagging because some people in Northern communities were hesitant to allow tagging. Using the DIDSON was seen as another option to obtain a population estimate, particularly in systems with low population numbers. Additionally, concerns over meeting the assumptions of mark-recapture also prompted examining the use of the DIDSON. The initial concept for the DIDSON was to obtain a population abundance estimate, knowing other species used the river, but the results in 2010 demonstrated that Dolly Varden from the Big Fish River continue to migrate during a time when camps need to be removed due to late fall weather conditions. It is difficult for researchers to stay in the mountainous area long enough to properly use this method.

It was pointed out that the migration pattern may vary among systems and that the DIDSON may work better in rivers where the migration is not as extended. A participant mentioned that there is less confidence in the DIDSON because fish were still moving upstream at the time the camera was removed. One individual stated that a longer period of calibration between both methods is necessary and that one year of data are insufficient to see how they compare. A final comment was made that it is too early to draw too many conclusions in comparing mark-recapture and DIDSON.

Regarding the Petersen mark-recapture estimate for 2010, participants agreed to apply the regression equation used to determine the expected annual increase in length of the smallest tagged fish, which is used to determine the total number captured while attempting to collect marked fish (i.e., the second sampling event) in the Petersen equation. Two different formulations of the regression were considered, (2009-2011 and 2010-2011). They each provided different values for the expected change in length of the smallest tagged fish which resulted in different numbers used in the Petersen equation for the number of fish captured during the second sampling event and resulted in different Petersen estimates of abundance for 2010. Participants agreed to use the regression from 2009-2011 as there were no statistically significant differences in the regression between 2009-2011 and 2010-2011, and that the regression was more robust with the combined data. It was noted that for the 2009 Petersen estimate, the same abundances estimate was generated from either the 2009-2010 or 2009-2011 regression equations.

A consensus was reached to express the mark-recapture population abundance estimates for fish ≥365 mm (minimum size of tagged fish) as opposed to ≥400 mm (the approach that was used to compare with counts of what would be considered Dolly Varden from the DIDSON sonar.

Due to the relatively low number of recaptures in 2009 and 2010, it was decided that 95% confidence intervals for the abundance estimates should be calculated based on the assumption that the probability of recapture followed a Poisson rather than normal distribution. It was pointed out that there was precedent in the published literature for using the Poisson distribution when number of recaptures was low. The Petersen estimate was chosen over

Bailey's triple capture because it was the method which had been used for previous estimates in the time series for Dolly Varden from the Big Fish River.

It was suggested that the DIDSON number could represent the minimum population size of Dolly Varden from the Big Fish River. One response was that this could not be the case because there were no confidence limits while someone else commented that any person can say they saw any number of fish and call it a minimum, and that there was no way to statistically justify the number. The Chair of the meeting stated that the limitation of the DIDSON data for the Big Fish River collected in 2010 has been made clear and that it was not the objective of the meeting to determine minimum population size and that discussions move forward.

PRESENTATION: EFFECTIVE POPULATION SIZE

Presenter: Les Harris

Genetic data used to calculate the effective population size (N_E) of Dolly Varden from the Big Fish River were presented. Two temporal methods were used to generate N_E estimates using samples collected in 1994 and 2009. Both methods produced similar estimates and the results suggested there is little evidence for concern for the stock regarding its genetic structure and evolutionary potential. A point estimate of the ratio of effective to census population size (N_E/N_C), reported in peer-reviewed literature, was applied to the N_E results as an innovative way to generate estimates of population size.

DISCUSSION

One participant wondered whether the N_E calculation included Dolly Varden from the resident life history type. It was mentioned that all samples analyzed were from anadromous fish and the N_E value was for anadromous fish. It was stated, however, that if these populations are not reproductively isolated, then the N_E estimates might be more difficult to interpret.

Another participant asked about the number of generations it would take to detect a change in the genetic fitness of the population after a decline in population size. The response was that it depended on the intensity of the population bottleneck and the initial amount of genetic variation in the population. Increases in genetic variation would have to come from immigration into the population or from genetic mutation, the latter of which would take much longer.

There was discussion among participants whether to attempt to combine all of the multiple population estimates and use the DIDSON results as a minimum number. The group concluded that it would be inappropriate to try and average across the different methods.

One participant mentioned that in approximately 1968 or 1969, a group of people with 11 snow machines went to the spawning/overwintering area in November and only captured 13 fish, although some areas of the river were frozen over with ice. The person wanted participants to know that there was a period in time when the population was low prior to the decline observed in the 1980s, and that our interpretation of a decline occurring in the 1980s may be incorrect.

PRESENTATION: BIOLOGICAL CHARACTERISTICS

Presenter: Colin Gallagher

Biological data on Dolly Varden that were captured (live-sampled) using a seine net at the spawning/ overwintering area of the Big Fish River at the end of September in 2009, 2010 and 2011 were presented. Specifically, the length characteristics for Dolly Varden that were not in spawning condition, lengths characteristics of males and females in spawning condition, length-

at-maturity, annual change in growth for males and females based on tag recapture data, the incidence of consecutive year spawning, and the proportion of spawners. Additionally, length frequency data from fish that were measured while passing in front of the DIDSON camera in 2010 were also presented. Data collected between 2009 and 2011 were compared to earlier sampling years in order to examine whether there had been any changes which could be used to further infer the current stock status.

DISCUSSION

A suggestion was made that one way to improve the graphical presentation of the length-at-maturity data would be to use stacked bars (i.e., combine males and females) when examining the change in length distribution between spawners and non-spawners. Another person suggested that instead of interpreting length at maturity using length frequency information that it could be more precisely quantified using logistic regression.

A point was made in regards to a graph showing the proportion of fish ≥500 mm observed using the DIDSON in 2010 and encountered in a weir in 1987, 1988 and 1991, that it would be better to compare the proportion among years starting at a length where the weir is selective for fish. The length information from the DIDSON included small sized fish that would not have been encountered by past weir studies, and by comparing the proportion of fish ≥500 mm from the DIDSON to the weirs, it was likely under-reporting the proportion. It was also mentioned that most fish ≥500 mm would be male spawners and that it would be better to look at the proportion of large size males and females separately.

PRESENTATION: MIXED STOCK FISHERY ANALYSIS

Presenter: Rob Bajno

Results from a genetic mixed-stock fishery analysis using samples from Herschel Island, Ptarmigan Bay, King Point and Shingle Point collected during the summer of 2011 were presented. The Canadian coastal samples were analyzed against a genetic baseline developed from known Dolly Varden source stocks from Canada and Alaska. The contributions from Alaskan stocks were not presented as it is a collaborative project between DFO and the United States Fish and Wildlife Service that is currently unpublished. Therefore, data from Alaskan stocks were pooled with the Firth River system creating a single reporting stock for the analyses. The percent contribution of individual source stocks to the harvesting locations along the Beaufort Sea coast, with 95% confidence intervals, was provided.

DISCUSSION

The presenter cautioned about using results from a single year in order to predict past and future contribution of stocks at harvesting locations, and that further sampling will be required in order to better understand the amount of annual variation. It was noted that prior studies from researchers in Alaska have demonstrated that there can be significant differences among years at coastal harvesting sites in Alaska and Canada.

It was also mentioned that the sampling of harvested Dolly Varden has to be done throughout the harvesting period in order to properly account for variation within a single sampling year. It was clarified that the monitoring program for Dolly Varden at Shingle Point in 2011 occurred during the majority of the period of time when people were fishing and catching char. While drafting the summary section, it was decided to combine the results from King Point and Shingle Point because King Point was an easily accessible fishing location from Shingle Point.

PRESENTATION: COASTAL HARVEST

Presenter: Ellen Lea

Harvest estimates from various locations along the Beaufort Sea coast between 2009 and 2011 were presented (data from Herschel Island were available between 2003 and 2011). Based on the results from the 2011 harvest monitoring program, the genetic mixed-stock fishery analysis and recent population estimates, a harvest rate for Dolly Varden from the Big Fish River was calculated.

DISCUSSION

Further examination of the archived harvest data from Shingle Point between 2003 and 2008 is required to properly tabulate the harvest records. It was also mentioned that the number of tag returns from the Dolly Varden harvest monitoring programs were too low to confidently use for determining the contribution of the Big Fish River stock to the fishery and that further analysis of these results to determine the probably of recapture for tags applied to Dolly Varden prior to 2010 was required.

A participant mentioned that summer coastal ice conditions were an important factor in determining how char are captured along the coast. They recounted that fourteen years ago in July, ice came in 10 miles from Shingle Point from the west and someone caught 60 fish within seven hours and that close to 200 char were caught in three days. The participants stated that when there's ice around there are fish and that when ice drifted away from Shingle Point, there were few char caught. The comment was made in order to underscore the point that ice conditions can cause variability in the timing of char migration which can affect harvest sampling, and therefore influence results of the mixed-stock fishery analysis.

Questions were raised about what information is important for co-managers to consider in their decision-making. It was stated that discussion should revolve around some of the cautions that should take place when establishing a harvest level for Dolly Varden from the Big Fish River. A suite of indicators should be developed to help make decisions on whether to increase or decrease the harvest rather than relying solely on the 5% of estimated population size (e.g., monitor changes in age structure, growth, habitat parameters). One person commented that harvest control rules are necessary to guide managers and in the absence of modelling information it is difficult to estimate risk to the stock for different harvest levels.

A participant stated that something useful for the integrated fisheries management process would be to state the level of confidence in the information collected and that is used by co-managers. For example, how confident are we in the population estimates or the impacts of the coastal fishery if there is uncertainty in the contribution of the stocks to the fishery? The participant wanted clearer statements on levels of uncertainty and what results managers should be more cautious about. Another participant stated that they had confidence in population estimates but asked about the level of confidence in the 5% harvest rate since this rule of thumb was based on a conservative interpretation of the results of a single study conducted on the sustainable harvest rate of slower growing Arctic char (*Salvelinus alpinus*). It was mentioned that when the working groups examine all the variables to make a decision about harvest level it is important to know if there are any special conditions to consider and whether there are information gaps that need to be addressed.

In discussing the possibility of a harvest of Dolly Varden at the mouth of the river, it was noted that the length structure was comprised of a wide range of sizes and had remained relatively unchanged, suggesting that births and deaths have been about the same across sampling

years. One question is that if another source of mortality is added, is there confidence that recruitment is going to be able to compensate? If there is an increase in mortality, will that affect the population level? The point was made that catch and effort needs to be monitored and that there is the possibility that no one will know the effect of fishing until it's happened. Further, it is important to collect biological data such as length, age, sex and weight and review these on an ongoing basis. If the assessment tools are not in place the effects of the fishery will not be understood.

A participant mentioned that establishing a framework for a monitoring program for a fishery at the mouth of the Big Fish River was beyond the scope of this meeting. It was mentioned that what the working group was seeking from this meeting had for the most part been discussed. Nearing the end of discussions, it was reiterated that there is currently no assessment model to evaluate harvest strategies to determine if they are sustainable or not.

MEETING WRAP-UP

Participants developed summary bullets of the relevant findings based on the all the scientific information that was presented. Participants agreed to the wording of the summary bullets which became the science advice produced from this regional advisory process meeting.

The Chair wrapped up the meeting with thanks to all participants.

APPENDIX 1. Terms of Reference

Terms of Reference

Assessment of and recommended sustainable harvest level for Dolly Varden from the Big Fish River, NT.

Central and Arctic Regional Advisory Process

February 29, 2012
Winnipeg, Manitoba

Chairperson: Margaret Treble

Context

Anadromous Dolly Varden (*Salvelinus malma*) is important for the subsistence of Gwich'in and Inuvialuit peoples. Due to declines in abundance of Dolly Varden from the Big Fish River, NT all fishing activity was prohibited in the river proper, including its tributary, the Little Fish River, and areas adjacent to its mouth in the Mackenzie River Delta in 1987. Currently, Dolly Varden from the Big Fish River are only harvested in a mixed-stock-fishery along the Beaufort Sea coast, mainly at Shingle Point, YT. Subsequent assessments (2002 and 2008) have demonstrated that population abundance has remained low and it is unclear whether this is a result of harvesting, changes in overwintering habitat that may influence carrying capacity or a combination of both. Recent population studies and coastal harvest monitoring activities that include the collection of catch information and biological data, tissue samples for genetic analysis, and tag returns allows a more comprehensive assessment of the stock. The Aklavik Hunters and Trappers Committee has requested a limited harvest of Dolly Varden from the Big Fish River. As a result, Fisheries and Oceans Canada (DFO) Fisheries Management has requested science advice on the current stock status, particularly the population abundance estimate and sustainable harvest level of Dolly Varden from the Big Fish River.

Objectives

This advisory meeting is being held to undertake a science-based peer review of all available information relevant to providing advice on the population abundance estimate and sustainable harvest level for the Big Fish River Dolly Varden stock, including the following:

1) Evaluation and comparison of population estimation methods (mark-recapture and Dual Frequency Identification Sonar [DIDSON]) used in recent assessments (2009 and 2010)).
2) Comparison of contemporary population estimates with past results.
3) Comparison of contemporary biological information (length, sex, maturity, and growth) with past data collected at the spawning/overwintering site.
4) Examination of the contribution of Dolly Varden from the Big Fish River to the mixed-stock-fishery at Shingle Point using genetic mixed stock analysis and recent tag return information.
5) Evaluation of recent Dolly Varden harvest statistics from Shingle Point (2010 and 2011) in the context of the mixed stock fishery composition.
6) Evaluation of the sustainable harvest level and the associated risks for the stock.

Expected publications

All reports will be published on the Canadian Science Advisory Secretariat (CSAS) website: http://www.dfo-mpo.gc.ca/csas/Csas/Home-Accueil_e.htm. The meeting will generate a proceedings report summarizing the deliberations of the participants which will be published in the CSAS Proceedings Series. In addition, there will be a CSAS Research Document produced from the working papers presented and reviewed at the meeting and a Science Advisory Report which will document the resulting advice.

Participation

Participants will include DFO Science, DFO Fisheries and Aquaculture Management, Fisheries Joint Management Committee, Aklavik Hunter and Trappers Committee, and other members of the scientific community (e.g., university researchers).

APPENDIX 2. List of participants

Name	Organization
Margaret Treble (Chair)	DFO Science Winnipeg
Ellen Lea	DFO, Fisheries and Aquaculture Management, Inuvik
Kimberly Howland	DFO Science Winnipeg
Steve Sandstrom	
Burton Ayles	Fisheries Joint Management Committee
Billy Archie	Fisheries Joint Management Committee
Danny C. Gordon	West Side Working Group
Melanie Toyne	DFO Science Winnipeg
Tracey Loewen	University of Manitoba
Kris Maier	Gwich'in Renewable Resources Board, Inuvik
Michael Papst	Fisheries Joint Management Committee
William Tonn	University of Alberta
Les Harris	DFO Science Winnipeg
Robert Bajno	DFO Science Winnipeg
Robert Young	DFO Science Winnipeg
Margaret Docker	University of Manitoba
Colin Gallagher	DFO Science Winnipeg
Kristen Adair (Rapporteur)	DFO Science Winnipeg

APPENDIX 3. Meeting agenda

Assessment of and recommended sustainable harvest level for Dolly Varden from the Big Fish River, NT.

Regional Advisory Process

Location: Freshwater Institute, small seminar room.

Date: February 29, 2012

Chair: Margaret Treble

9:00-9:15	Introduction and Review of Terms of Reference. (M. Treble).
9:15-10:30	Population abundance estimates (ToR 1 and 2) (C. Gallagher).
10:30-10:45	Break.
10:45-11:30	Effective population size results (ToR 2) (L. Harris).
11:30-12:00	Biological characteristics (ToR 3) (C. Gallagher).
12:00-13:15	Lunch.
13:15-13:45	Harvest statistics (ToR 5) (E. Lea).
13:45-14:30	Mixed-stock fishery analysis (ToR 4) (R. Bajno).
14:30-14:45	Break.
14:45-15:30	Sustainable harvest and associated risk discussion (ToR 6).
15:30-16:15	Summarize conclusions of the assessment.
16:15-16:30	Wrap up/ closing remarks.